

Amendment on August 11, 2004

10/540527

AMENDMENT JC17 Rec'd PCT/PTO 24 JUN 2005

(Amendment under of Article 11 of the Japanese Law [PCT Article 34(2)(b)])

To: Commissioner of the Patent Office

1. Identification of the International Application

PCT/JP03/016542

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4. Items to be Amended

Description and Claim

5. Contents of Amendment

(1) "which has a particle size of 30 to 125 μm ," in claim 1 is amended to "which has: a particle size of 30 to 125 μm ;"

(2) "the remainder being Fe" in claim 1 is amended to "the remainder being Fe; a crystallization temperature (Tx) of 770 to 800 K; and a liquidus temperature (Tl) of 1220 to 1300 K."

(3) "at a temperature of 573 K or more" in claim 2 is amended to "in a temperature range of 573 K to the crystallization temperature (Tx)".

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(4) "and a coercive force (H_c) of 19 (A/m) or less" in claim 2 is amended to ", a coercive force (H_c) of 19 (A/m) or less and a specific resistance of $1.6\ \mu\Omega\text{m}$ or more".

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What is claimed is:

1. (Amended) A spherical particle for use in producing a bulk Fe-based sintered alloy soft magnetic material of metallic glass, comprising a Fe-based metallic glass alloy prepared by an atomizing process, which has: a particle size of 30 to 125 μm ; a composition consisting of, by atomic %, 0.5 to 10 % of Ga, 7 to 15 % of P, 3 to 7 % of C, 3 to 7 % of B and 1 to 7 % of Si, with the remainder being Fe; a crystallization temperature (T_x) of 770 to 800 K; and a liquidus temperature (T_l) of 1220 to 1300 K.

2. (Amended) A bulk Fe-based sintered alloy soft magnetic material of metallic glass, which consists of a metallic glass phase high-density sintered body with a relative density of 99.0 % or more, prepared by sintering the plurality of spherical particles of Fe-based metallic glass alloy as defined in claim 1 in a temperature range of 573 K to the crystallization temperature (T_x), and has a magnetic permeability of 3900 (μ_{max}) or more, a coercive force (H_c) of 19 (A/m) or less and a specific resistance of 1.6 $\mu\Omega\text{m}$ or more in an as-sintered state, wherein said metallic glass has:

a temperature interval of a supercooled liquid region (ΔT_x) of 25 K or more, as expressed by the following formula: $\Delta T_x = T_x - T_g$, wherein T_x is a crystallization temperature, and T_g is a glass transition temperature; and

a reduced glass transition temperature of 0.59 or more, as expressed by the following formula: T_g / T_l , wherein T_g is a glass transition temperature, and T_l is a liquidus temperature.

3. A bulk Fe-based sintered alloy soft magnetic material of metallic glass, prepared by subjecting the bulk Fe-based sintered alloy soft magnetic material as defined in claim 2 to a heat treatment in a temperature range of 573 to 723 K, which has a magnetic permeability of 7000 (μ_{max}) or more and a coercive force (H_c) of 12 (A/m) or less.

4. A method of producing the spherical particle as defined in claim 1, comprising:

preparing molten alloy having a composition consisting of, by atomic %, 0.5 to 10 %

of Ga, 7 to 15 % of P, 3 to 7 % of C, 3 to 7 % of B and 1 to 7 % of Si, with the remainder being Fe;

dropping or ejecting said molten alloy from a nozzle; and

spraying high-speed gas to droplets of said molten alloy to rapidly solidify said droplets to obtain a Fe-based metallic glass alloy particle having an amorphous phase and a maximum particle size of 30 to 125 μm .

5. A method of producing the Fe-based sintered alloy soft magnetic material as defined in claim 2, comprising:

preparing a plurality of spherical particles of Fe-based metallic glass alloy having a particle size of 30 to 125 μm by the method as defined in claim 4; and

sintering said spherical particles by a spark plasma sintering process under the conditions that: a heating rate is set at 40 K/min or more; a sintering temperature (T) is set at 573 K or more and within a temperature range satisfying a relationship of $T \leq T_x$, wherein T_x is a crystallization temperature; and a sintering pressure is set at 200 MPa or more.

6. A method of producing the bulk Fe-based sintered alloy soft magnetic material of metallic glass as defined in claim 3, comprising:

preparing a Fe-based sintered alloy soft magnetic material by the method as defined in claim 5; and

subjecting said Fe-based sintered alloy soft magnetic material to a heat treatment in a temperature range of 573 to 723 K.